

Appl No.: 10/655,986
Reply to Office Action of November 03, 2006

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REMARKS/ARGUMENTS

Favorable consideration of this application is respectfully requested. Applicant has amended the independent claims 1, 21, and 25 and added a new claim 31. Dependent claims 7 and 22 are cancelled because they are now incorporated in the relevant independent claims. Claims 29-30 are cancelled because new Claim 31 provides a better statement of the invention. Claims 8-20 are cancelled because of a restriction requirement. Claims 1-3, 21, 23-28 and new claim 31 are now pending. No new matter has been entered. Favorable reconsideration is earnestly solicited in view of the following remarks.

Support for the amendments to claim 1, in the sequence of entry, is found in the specification, as follows: Beginning with support for "pure and free of foreign oxides" on page 4, lines 1-3. Support for the following amendments to Claim 1 is found on page 5, lines 6-7 and 9, page 15, lines 12-14; original Claim 8, page 7, lines 7-23, page 8, lines 1 - 13; paragraph bridging pages 6 and 7, page 9, lines 17-18 page 11, lines, 17 - 20, Figures 6a, 6b, page 15, lines 14-17.

Support for new claim 31 is found in the original claims 29-30 and in the specification on page 7 lines 16-20, and page 8, lines 12-21.

In paragraphs 1, 2 and 3 on page 2, under the heading "Claim Rejections - 35 USC § 102" of the Office Action of November 03, 2006, the Examiner rejects Claims 1-2, 4-5, 25-27, 29-30 under 35 U.S.C. 102(b) as being anticipated by Atita (U.S. Patent 5,472,795).

The Examiner argues, in paragraph 3 of the Office Action, that "Atita teaches a nanolaminate of zirconium oxide containing a thin layer of polycrystalline metastable tetragonal zirconia deposited on a support (substrate). . ." The Examiner also points out that Atita's particle sizes are less than 13 nm and inherently spherical, "... regardless of their production method".

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Applicant takes exception to the Examiner's unsupported assertion that Atita's particles are "inherently spherical" and finds significant differences in Applicant's amended claims and the teachings of Atita.

First, Atita does not teach or suggest a process for making zirconia particles of any size or shape. Secondly, Atita teaches the use of vacuum sputter deposition to laminate zirconia in layer form on a substrate. In contrast, Applicant claims the sol-gel synthesis of unsupported (no substrate) zirconia powders having aggregation and loose agglomeration properties responsible for high-temperature metastable tetragonal phase stability of monodispersed, spherical zirconia particles approximately 10 to approximately 600 nm in diameter. Third, Applicant teaches the use of an organic polymer stabilizer during the sol-gel preparation of zirconia powders; in contrast, Atita does not use organic polymers during vacuum sputter deposition, which is an application process for zirconia laminates, not a synthesis technique.

In paragraph 4, page 2 of the Office Action of November 03, 2006, the Examiner argues that "Atita further teaches that the zirconia can be 100% tetragonal zirconia substantially free of stabilizing dopant (oxides). . ." and "regarding claims 29-30, the monodispersed particles are interpreted to have constituted a powder pre-lamination." Again, Applicant argues that the Atita reference only describes a type of zirconia particle that can be used in a vacuum sputter deposition process for laminating surfaces; this teaching does not begin to suggest Applicant's novel process for preparing unique zirconia particles using sol-gel synthesis of unsupported (no substrate) zirconia particles having aggregation and agglomeration properties responsible for high-temperature metastable tetragonal phase stability of monodispersed, spherical zirconia particles approximately 10 to approximately 600 nm in diameter. Applicant's zirconia particles aggregate

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and agglomerate to form stabilized high temperature metastable tetragonal phase particles that do not shift to the monoclinic phase.

Applicant's invention teaches how to prepare zirconia particles larger than 6nm that have aggregation and loose agglomeration properties that suppress volume increase associated with the tetragonal-to-monoclinic phase transformation of zirconia particles. Atita does not teach how to avoid the phase shift as shown in claim 3 of U.S. Patent 5,472,795 where Atita claims that the zirconia layer consists of mixed metastable tetragonal and monoclinic phases.

Prior to Applicant's synthesis using a sol-gel technique, it was not known that zirconia particles larger than 6 nm could be stabilized in the 100% tetragonal phase. Thus, it is understandable that Atita claims a zirconia layer having a maximum thickness of 6 nm that consists of a metastable tetragonal phase substantially free of a monoclinic phase. See Claims 2 and 4 (U.S. Patent 5,472,795).

As stated in *Greer Hydraulics, Inc. v. Rusco Industries, Inc.*, 185 USPQ 83 (DC, C.D. Cal. 1974), "[t]here is no anticipation under 35 U.S.C. 102 where no single prior art discloses all elements of claims."

Applicant's amendments to the Claims clearly distinguish the present invention from Atita '795; accordingly, Applicant respectfully request the withdrawal of the rejection of Claims 1-2, and 25-27, under 35 U.S.C. 102(b) as being anticipated by Atita (U.S. Patent 5,472,795). The rejections of Claims 4-5 and 29-30 are now moot, as these Claims have been canceled.

Referring now to the Examiner's rejections on pages 3-4, under the heading "**Claims Rejections – 35 USC § 103**", of the Office Action of November 03, 2006, Applicant has amended the claims to clearly identify and claim the inventive features of Applicant's invention and thereby

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distinguish the present invention from each of the references, or combination of references, cited by the Examiner.

No cited reference, individually, or in combination with other references, teaches or suggests the sol-gel synthesis of unsupported (no substrate) zirconia particles having aggregation and loose agglomeration properties responsible for high-temperature metastable tetragonal phase stability of monodispersed, spherical zirconia particles approximately 10 to approximately 600 nm in diameter. The zirconia particles prepared by the sol-gel technique are pure and free of foreign oxides, exhibit metastable tetragonal crystal structure at room temperature and are suitable for forming durable coatings on metallic and ceramic substrates.

Applicant now addresses each rejection in the numerical sequence of each paragraph in the Office Action.

In paragraph 6 on page 3, of the Office Action of November 03, 2006, Claims 1-2, 3, 4-5, 6, 25-27, 28, 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atita (U.S. 5,472,795) in view of Montino (U.S. 5,002,909). The Examiner argues in paragraph 7 that Atita teaches a nanolaminate of zirconium oxide containing a thin layer of polycrystalline metastable tetragonal zirconia deposited on a support. The Examiner further argues that the crystalline particles of Atita are "...preferably less than 13 nm."

Claims 1-2, 3, 4-5, 6, 25-27 are now amended and/or dependent on an amended Claim to distinguish Applicant's invention from Atita. As argued above, Atita teaches vacuum sputter deposition to laminate zirconia in layer form on a substrate. In contrast, Applicant claims the sol-gel synthesis of unsupported (no substrate) zirconia particles. There is no suggestion or teaching in Atita that the room temperature sol-gel synthesis of monodispersed spherical zirconia (ZrO_2) particles would have aggregation and loose agglomeration properties that suppress volume

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increase associated with the tetragonal-to-monoclinic phase transformation for high-temperature metastable tetragonal phase stability of zirconia particles approximately 10 to approximately 600 nm in diameter.

Prior to Applicant's invention, there was a critical size of approximately 6 nm required for the stabilization of zirconia particles in a substantially 100% tetragonal phase. Applicant has stabilized both nano and large sized zirconia particles by using the sol-gel synthesis technique. Atita does not teach the synthesis of zirconia particles of any size or shape, but uses particles of approximately 6nm in size that are known to be approximately 100% stable in the tetragonal phase in a lamination process.

Further, the Examiner argues in paragraph 8, that "Montino (U.S. 5,002,909) teaches spherical particles of mixed oxides of alumina and zirconia, stabilized at room temperature in a crystalline tetragonal phase. ... consisting essentially of non-agglomerated particles in a particle size from 0.1 to 1 micrometer." (*Underlining added for emphasis.*)

Applicant respectfully points out the following differences between Montino's teachings and Applicant's invention. First, Montino forms mixed oxides of alumina and zirconia, in contrast, Applicant forms only oxides of zirconium. Second, Montino uses a "precipitation technique" not a sol-gel technique as required by Applicant. Third, the precipitation technique of Montino uses an aqueous solvent, in contrast to Applicant's use of an organic (alcohol) solvent in the sol-gel process. Fourth, Montino's precipitation technique uses non-alkoxide precursors, such as nitrates, chlorides and sulphates; in contrast, Applicant uses an alkoxide precursor (such as, zirconium (IV) n-propoxide). Fifth, Montino uses polyelectrolytes having cationic groups distributed regularly on the polymeric chain; in contrast, Applicant uses organic polymers having -OH and/or ether groups in the chemical structure. A person of ordinary skill in the art knows

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that the five differences in the chemical processes set forth above will result in products of different properties and performance characteristics.

Accordingly, Applicant's zirconia particles have aggregation and loose agglomeration properties that suppress volume increase associated with the tetragonal-to-monoclinic phase transformation for high-temperature metastable tetragonal phase stability of monodispersed, spherical zirconia particles approximately 10 to approximately 600 nm in diameter; in contrast, Montino has mixed oxides of alumina and zirconia that are "...spherical, submicronic, non-agglomerated particles." See claim 7, column 16, lines 58-59 (U.S. 5,002,909).

Applicant's zirconia particles, prepared by a sol-gel technique, are also pure and free of foreign oxides and exhibit metastable tetragonal crystal structure at room temperature. Whereas, Montino requires the use of aluminum oxide and forms mixed oxides of aluminum and zirconia wherein "...zirconia ... [is] stabilized in the tetragonal phase at room temperature, after having subjected said amorphous mixed oxides to thermal treatment for converting zirconia into the tetragonal phase." See Claim 7, col. 16, lines 64-48. Montino uses thermal treatment to convert zirconia into the tetragonal phase. Montino provides no suggestion or teaching that zirconia particles could be synthesized using a sol-gel technique and exhibit the aggregation and loose agglomeration properties that result in a stable tetragonal crystal structure.

Thus, Applicant finds the combination of the teachings of Atita in view of Montino to be without merit as a basis for rejecting Applicant's claims. Atita teaches vacuum sputtering deposition of zirconia particles to form laminates and Montino teaches a precipitation technique for forming mixed oxides of aluminum and zirconium. The combined teachings provide no incentive for preparing the novel zirconia particles of Applicant's that are approximately 10 to approximately 600 nm and pure and free of foreign oxides.

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Responding now to specific rejections in paragraphs 9 – 14, Applicant finds that the Examiner's arguments in paragraph 9 are no longer applicable in view of the amendments made to Claim 1 where the novel product is characterized in greater detail and is thus distinguished from Atita's teaching that "zirconia can be 100% tetragonal, substantially free of stabilizing dopant (oxides)" because the teaching in Atita is directed to zirconia particles of approximately 6 nm; in contrast Applicant's particles are from 10 to 600 nm and are formed by a sol-gel technique that causes the particles to have aggregation and loose agglomeration properties that exhibit a stable 100% tetragonal crystal structure.

In paragraph 10, Claims 29-30 are rejected because the "monodispersed particles are interpreted to have constituted a powder pre-lamination." Claims 29-30 have been canceled; therefore, this rejection is now moot.

In paragraph 11, the Examiner argues that "...the process by which a product is obtained is not indicative of the patentability of a claim to the product wherein the product is otherwise taught." Applicant respectfully disagrees. The product herein was not known prior to Applicant's invention. Applicant has pointed out in detailed arguments above that all zirconia particles are not created equally. Prior to Applicant's invention, it was not known that nano and large size zirconia particles could be formed by a sol-gel technique and would not shift from the metastable tetragonal phase to the monoclinic phase, but retain a commercially preferred, substantially 100% tetragonal crystalline structure.

In paragraph 12, the Examiner argues that Claims 3 and 28 have particle sizes in the 500-600nm range which is within the range of particle sizes taught by Montino. Applicant's amended claims have pointed out a distinction between the zirconia particles of Applicant and the mixed

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oxide particles of Montino. Thus, the comparison of particles of the same or overlapping size is deemed improper, as if comparing apples and oranges of the same size.

In paragraph 13, the Examiner argues that "[i]t would have been obvious to one of ordinary skill in the art to substitute the spherical zirconia particles of Montino for the particles of Atita because both have tetragonal phases, are monodispersed," etc. In view of Applicant's amended claims the Examiner's argument is untenable. Montino has mixed oxide spherical particles and Atita has 6nm zirconia particles that have a tetragonal phase, as known in the art.

In paragraph 14, Examiner further argues that "...it would have been obvious to one of ordinary skill in the art at the time of the invention to use the method of Montino (a non sol-gel technique) to make the zirconia particles of Atita in order to obtain a spherical particle." Again, Applicant finds this argument untenable because Montino's precipitation process gives a very different product -- a mixed oxide, while the use of the sol-gel process of Applicant provides the novel zirconia particles larger than 6nm that retain the tetragonal crystalline structure and do not shift to the monoclinic phase. Differences in the processes and products have been set out above and claims have been amended accordingly.

With regard to the Examiner's arguments in paragraphs 13 and 14, the combination of Atita in view of Montino is impermissible under well established case law, to defeat the patentability of the invention being examined. In *In re Rouffel*, 47 USPQ 2d 1453, at 1457-1458 (Fed. Cir. 1998), the Court said "[t]o prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references

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for combination in the manner claimed." No motivation for the combination of these references has been shown absent Applicant's invention.

In view of the above, Applicant respectfully requests the withdrawal of the rejection of Claims 1-2, 3, 4-5, 6, 25-27 under 35 U.S.C. 103(a) as being unpatentable over Atita (U.S. Pat. 5,472,795) in view of Montino (U.S. Patent 5,002,909). The rejection of Claims 4-6, which are now canceled, is considered moot and it is respectfully requested that the rejection be withdrawn.

Referring now to paragraphs 15 - 19, on page 5 of the Office Action of November 03, 2006, Claims 21, 23, 24 and 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atita (U.S. 5,472,795) in view of Montino (U.S. 5,002,909) further in view of Allen (U.S. 6,652,987).

The Examiner argues, in paragraph 16, that Atita in view of Montino are silent as to the presence of a metal substrate; however, Atita does teach that the substrate can be virtually any desired material that can be provided with a tough coating. Allen teaches that it is known to use tetragonal zirconium oxide thermal barrier coatings on metals (paragraph 17 of the Office Action). There is no suggestion or teaching that novel zirconia (ZrO_2) particles prepared by a sol-gel process that are pure and free of foreign oxides could be formed, as disclosed by Applicant and used for coating a metal substrate.

Further distinctions between Allen's patent and Applicant's invention are the teachings with regard to stabilizing the tetragonal (ZrO_2) particles. Allen supra at column 1, lines 30-33 states: "Yttrium, magnesium, calcium and/or other suitable oxide is typically added to the zirconium oxide to stabilize the tetragonal and/or cubic crystal structure required for coating durability." This teaches away from Applicant's invention. It was not known, nor envisioned that spherical (ZrO_2) particles, larger than 6nm, could be prepared by a sol-gel process pure and free of

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foreign oxides with aggregation and loose agglomeration properties that suppress volume increase associated with the tetragonal-to-monoclinic phase transformation for high-temperature metastable tetragonal phase stability; these zirconia particles are also suitable for forming durable coatings. In contrast, Allen uses and teaches (ZrO₂) particles stabilized with other oxides for coating durability.

In paragraph 18, the Examiner argues that claim 24 "would have been obvious to have the particle size between 500-600 nm since Montino teaches an overlapping range of particles. Applicant respectfully disagrees. All zirconia particles are not the same and do not perform the same as has been pointed out above. Applicant's claims have been amended to include the novel features of the zirconia particles.

In paragraph 19, the Examiner argues that "[i]t would have been obvious to one of ordinary skill in the art at the time of the invention to put the coating of Atita on a metal substrate because the substrate can be virtually any desired material ..." Applicant agrees that tetragonal zirconium oxide thermal barrier coatings for metal substrates are known; however, the novel zirconia particles taught and claimed by Applicant were not known to exist and thus, were not obvious to one of ordinary skill in the art. Applicant's amended claims include the novel features of Applicant's zirconia particles.

The Examiner has essentially used Applicant's invention as the basis for citing and combining three references to reject Applicant's invention under U.S.C. 103(a). As stated in In re Wesslau, 147 USPQ 391 (CCPA 1965), when rejections are made under 35 U.S.C. 103, the question is "... whether subject matter as a whole would have been obvious to one of ordinary skill in the art following teachings of prior art at time invention was made; it is impermissible within the framework of Section 103 to choose from any one reference only so much of it as will

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support a given position, to exclusion of other parts necessary to full appreciation of what the reference fairly suggests to one of ordinary skill in the art."

The subject matter of Applicant's invention as a whole is not taught or suggested by Alita in view of Montino, further in view of Allen. Neither reference individually, or in combination teaches or suggests zirconia (ZrO_2) particles, approximately 10 to approximately 600 nm in diameter, prepared by a sol-gel technique, pure and free of foreign oxides with aggregation and loose agglomeration properties that suppress volume increase associated with the tetragonal-to-monoclinic phase transformation for high-temperature metastable tetragonal phase stability thereof. The metastable tetragonal crystal structure at room temperature makes the zirconia particles of this invention suitable for durable coatings on metallic and ceramic substrates.

In view of the amendments to independent claims and arguments presented above, Applicant respectfully requests the withdrawal of the rejection of Claims 21, 23, 24 and 25-27 under 35 U.S.C. 103(a) as being unpatentable over Alita (U.S. 5,472,795) in view of Montino (U.S. 5,002,909) further in view of Allen (U.S. 6,652,987).

Applicant acknowledges paragraph 20 of the Office Action of November 3, 2006 in which the Examiner withdraws the obvious rejection of Leushake (U.S. 6,168,833) in view of Allen.

If allowable subject matter is found by the Examiner, Applicant's respectfully request the rejoinder of Claims 8 - 20 that are directed to the process used for making the novel zirconia particles of the present invention. Claims 8 - 20 can be added as dependent claims on the currently amended claims that now include the process for making the novel product.

The application and claims are believed to be in condition for allowance in their amended form; allowance of Claims 1-3, 21, 23-28 and 31 is respectfully requested. If the Examiner

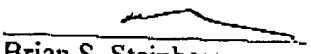
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believes that an interview would be helpful, the Examiner is requested to contact the attorney at the below listed number.

Respectfully submitted,


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